



# STUDIES

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## HEAD AND SPINAL CORD INJURY IN NORTH CAROLINA

by

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### ABSTRACT

In recent years North Carolina has recognized the need to confront injury as one of the major, preventable health problems in this state. Traditionally, injuries have been regarded as unavoidable events. Injuries, however, have been found to be both predictable and preventable (1).

Head and spinal cord injuries are particularly devastating because the severe nature of many of these injuries leads to death or permanent disability. Using the North Carolina death files, this study examines resident head and spinal cord injury mortality from 1979 to 1988. Mortality data are then compared to hospital discharge data from the Medical Database Commission. Head injury was involved in 11,317 deaths during this period, spinal cord injury in 493 deaths.

Head injury-associated death (HIAD) is most often related to motor vehicle collisions, falls, homicide, and suicide. For both whites and nonwhites, males are at much greater risk of HIAD than females. Age groups most affected are those 15-24 and 75 and older. By race, rates are generally higher for nonwhites than whites. A comparison of the HIAD portion of this study to a national HIAD study reveals higher state rates overall but similar age-specific rates. There are also differences in the proportion of HIADs by cause, with an excess of motor-vehicle-related HIAD in North Carolina.

Spinal cord injury-associated death (SCIAD) is most often related to motor vehicle collisions and falls. Again, males are at a much higher risk of SCIAD than females. Rates increase at ages 15-24, level off, then rise sharply after age 65. In general, rates are higher for nonwhites than whites, particularly nonwhite males.

A comparison of 1988 mortality and hospital discharge data reveals that, for every death from head injury, another 4.4 persons were hospitalized with a head injury. The corresponding ratio for spinal cord injury was 6.0. The relationship between HIADs or SCIADS and hospitalized survivors varies by age group and sex group.



## INTRODUCTION

Head injury has been referred to as "one of the most feared of all acute injuries"; not only because it can cause death, but because it can cause "sustained physiologic, psychologic, and functional impairment" (2). Likewise, "a spinal cord injury resulting in loss of motor or sensory function" has been described as "one of the most catastrophic medical conditions recognized" (3). For survivors of severe head and spinal cord injury there is a likelihood of disability, and often, a shortened life expectancy (4). Approximately 500 to 1,000 North Carolinians are severely disabled as a result of head injury each year (5). Estimates indicate approximately 165 to 295 North Carolinians are affected by an acute traumatic spinal cord injury each year (6). Head and spinal cord injury affect not only the injured individual, but the family, community, and society at large. Economic losses due to head and spinal cord injury are estimated in the billions of dollars each year (6,7). Not only are there direct costs for medical care but indirect costs as well, such as lost productivity and years of life lost.

To develop prevention strategies for head and spinal cord injury there first must be an understanding of the circumstances under which these injuries occur and the populations affected. This study examines death records over a 10-year period (1979 through 1988) to determine the incidence and causes of head and spinal cord injury death. Mortality data for this study are from the North Carolina death files; hospital discharge data are from the North Carolina Medical Database Commission. Inpatient discharge data from the Medical Database Commission were available only for calendar year 1988, however, allowing for only single-year comparisons of mortality and morbidity data.

## METHODS

Head injury-associated death (HIAD) was determined by using the same criteria for selection used in a national study of HIAD by the Centers for Disease Control (8). The underlying cause of death and 20 other conditions are coded on the death certificate using the International Classification of Diseases, Ninth Revision (9). All records with an intentional or unintentional injury (codes E800-E999) listed as the underlying cause of death were selected. A death was then classified as a HIAD if one or more of the following conditions (N-codes) was present on the death record: fracture of the vault or base of the skull (N800.0-N801.9); other and unqualified and multiple fractures of the skull (N803.0-N804.9); intracranial injury, including concussion, contusion, laceration, and hemorrhage (N850.0-N854.9); late effects of fracture of the skull and face (N905.0); and late effects of intracranial injury without skull fracture (N907.0). E-codes indicate external cause of the injury while N-codes indicate the injury diagnosis.

Spinal cord injury-associated death (SCIAD) was determined in a similar manner using the following mentioned conditions: fracture of vertebral column with spinal cord injury (N806.0-N806.9), spinal cord injury without evidence of spinal bone injury (N952.0-N952.9), and late effect of spinal cord injury (N907.2).

Identification of a death as a HIAD or a SCIAD (as defined above) implies only that a head or spinal cord injury was present at the time of death. Often there were additional conditions contributing to the death. However, among 1988 HIAD records, head injury was the first mentioned condition in the majority of the cases. For the majority of SCIADs, spinal cord injury was either the first or second mentioned condition.

HIAD and SCIAD cases are not mutually exclusive. A death was counted as both a HIAD and SCIAD if both a head injury and a spinal cord injury were indicated as a mentioned condition of death. Approximately 23 percent of those dying with a mention of spinal cord injury also had a mention of head injury. In comparison, only one percent of those dying with a head injury had a spinal cord injury.



The Medical Database Commission collects inpatient data using the UB-82 claim form, a billing form used by hospitals. Because this form was originally designed for billing and not research purposes, information such as patient's race and cause of injury (E-code) was not available for this study. This comparison is limited to morbidity and mortality cases among age groups and sex groups. Head and spinal cord injury records were selected by searching the five diagnoses fields of each record. The same N-codes used for selection of HIADs and SCIADs were used for selection of morbidity cases. HIAD and SCIAD cases include residents dying in and outside of North Carolina. Morbidity cases include in-state hospitalizations regardless of residence. Information on injured residents hospitalized out of state is unavailable. In order to compare resident deaths (in and out of state) with a comparable estimate of resident hospitalizations, the assumption has been made that hospitalizations to residents out of state are approximately equivalent to hospitalizations of non-residents in North Carolina. Because deaths occur among the hospitalized, there is an overlapping of mortality and morbidity cases. To allow for a comparison of the two different types of cases (deaths versus survivors), the number of inpatient deaths (as indicated in the death file) was subtracted from the number of inpatient cases.

Rates were calculated using deaths or inpatient cases and population estimates by age/race/sex for the time periods noted. Adjusted rates were calculated using the N.C. or U.S. 1980 Census population as the standard. Race groups were whites and either nonwhites or blacks. During 1980, whites made up 76 percent of the North Carolina population; 22 percent were black, one percent American Indian and 0.7 percent other races (10). All rates were per 100,000 residents. Rates based on fewer than 20 events are likely to be unstable and should be used very cautiously in making comparisons.

In accordance with a recommendation by the N.C. Governor's Task Force on Injury Prevention and Control, the term "injury" is substituted for "accident" (except where "accident" appears as a part of a specific heading from the International Classification of Diseases, 9th Revision). The term "accident" is generally used to refer to unexpected events and is counterproductive to preventive measures focusing on the predictable and preventable nature of injury (11).

## HEAD INJURY-ASSOCIATED DEATHS

Tables 1 and 2 show the number of deaths and death rates respectively for 1979-88 HIADs by age, race, sex and underlying cause of death. These data and other details about North Carolina head injury deaths are highlighted below.

From 1979 through 1988, head injury was involved in almost 26 percent of all injury deaths in North Carolina, claiming the lives of 11,317 residents. More than two-thirds of these decedents were ages 44 and younger, with the largest proportion being 15-24. This coincides with the fact that injury is the leading cause of death between the ages of 1 and 45 and the leading cause of years of life lost (12). It accounts for more average years of life lost than any other cause (see Table 3). The majority of HIADs are males with a male-to-female ratio of 2.8. These injury deaths are most frequently related to the four leading causes of all injury deaths: motor vehicle collisions (MVCs) (E810-825), falls (E880-E888), homicide (E960-E969), and suicide (E950-E959) (see Figure 1).

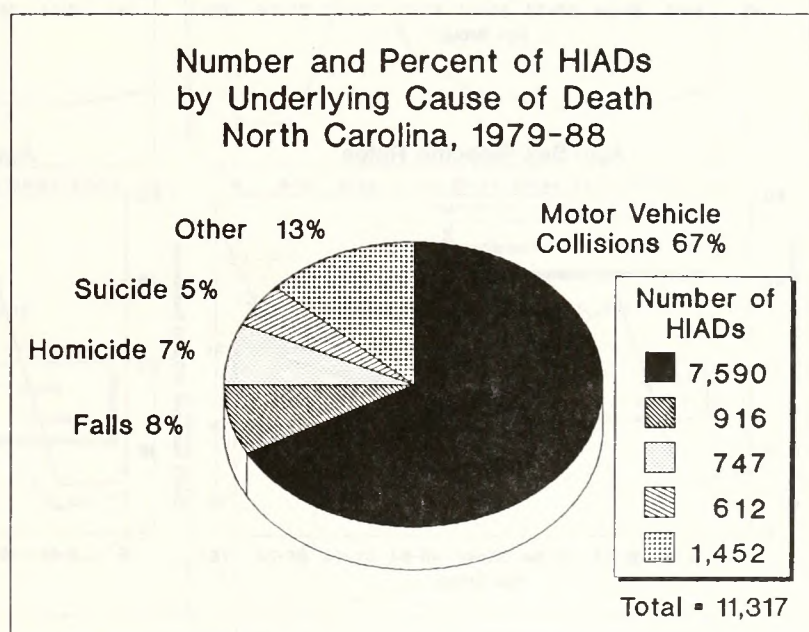


FIGURE 1



Age-specific death rates for 1979-88 show a distinct bimodal pattern with peaks at ages 15-24 and ages 75 and older. As shown in Figure 2, HIAD rates differ between race groups with age-specific rates for whites similar to the age-specific rates for total HIADs. Rates for nonwhites are higher in every age group except 15-24 and 75 and older. The age-sex-adjusted rate for nonwhites is also higher than that for whites (see Table 4), indicating that the difference in rates is not due to the age-sex distribution of the races.

Age-sex-specific death rates (Figure 2) show the familiar bimodal pattern with rates higher for males than females across all age groups. Both sexes are at greatest risk of HIAD at ages 15-24 and ages 75 and older. The age-race-adjusted rate (Table 5) is also higher for males than females.

Among race-sex groups, white males and females show the same bimodal pattern of rates across age groups (Figure 2). Rates for nonwhite males are higher in all age groups but 15-24 and 75 and older. While rates are higher for males than females, there is a greater difference in rates between nonwhite males and females than between white males and females. The age-adjusted rate for nonwhite males is higher than that for white males but the rate for white females is higher than that for nonwhite females (see Table 6).

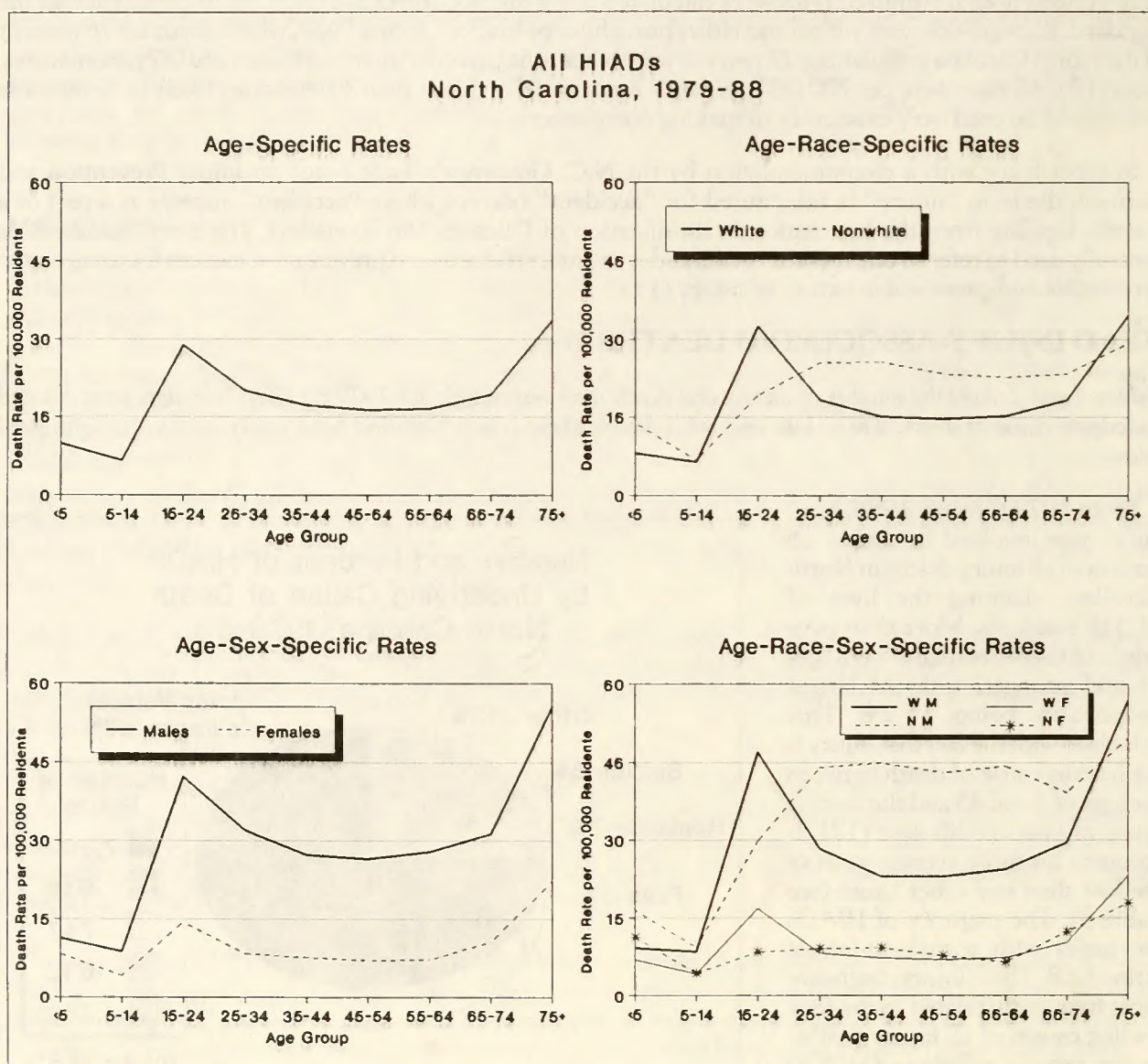


FIGURE 2



In general, annual HIAD rates declined from 1979 to 1983, rose slightly, then remained fairly constant. A comparison of age-race-sex-adjusted rates indicates that the decline was not due to shifts in the age-race-sex distribution of the population (see Table 7). The decline was probably due to a reduction of motor vehicle collision (MVC)-related HIADs during this time period.

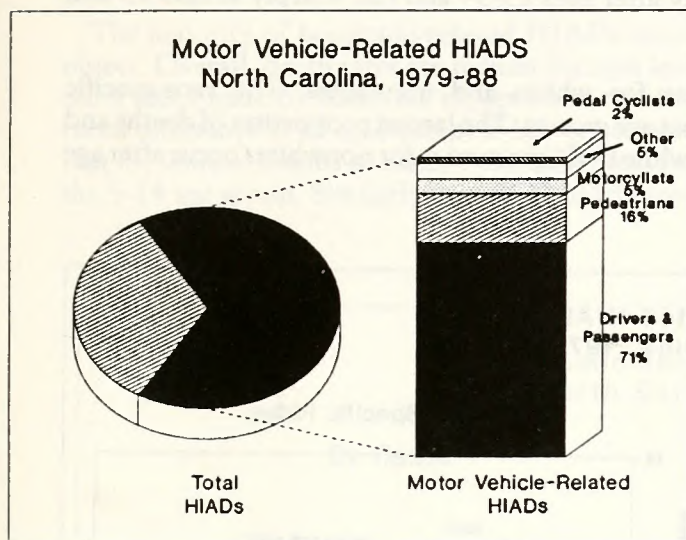


FIGURE 3

As shown in Figure 3, drivers and passengers of a motor vehicle (other than a motorcycle) account for the majority of **MVC-related HIADs**. Other deaths include pedestrians, motorcyclists and motorcycle passengers, and pedal cyclists. Because the majority of HIADs are related to MVCs, the patterns of these rates by age, race and sex are similar to those for total HIADs. However, there is generally a single peak of rates in the 15-24 age group versus the more bimodal pattern for total HIADs (see Figure 4). White males in particular show an excess of MVC-related HIAD at ages 15-24. Nonwhite males tend to be at greatest risk at ages 25-34. Annual adjusted rates for MVC-related HIADs follow the same pattern as those for all HIADs (see Table 7).

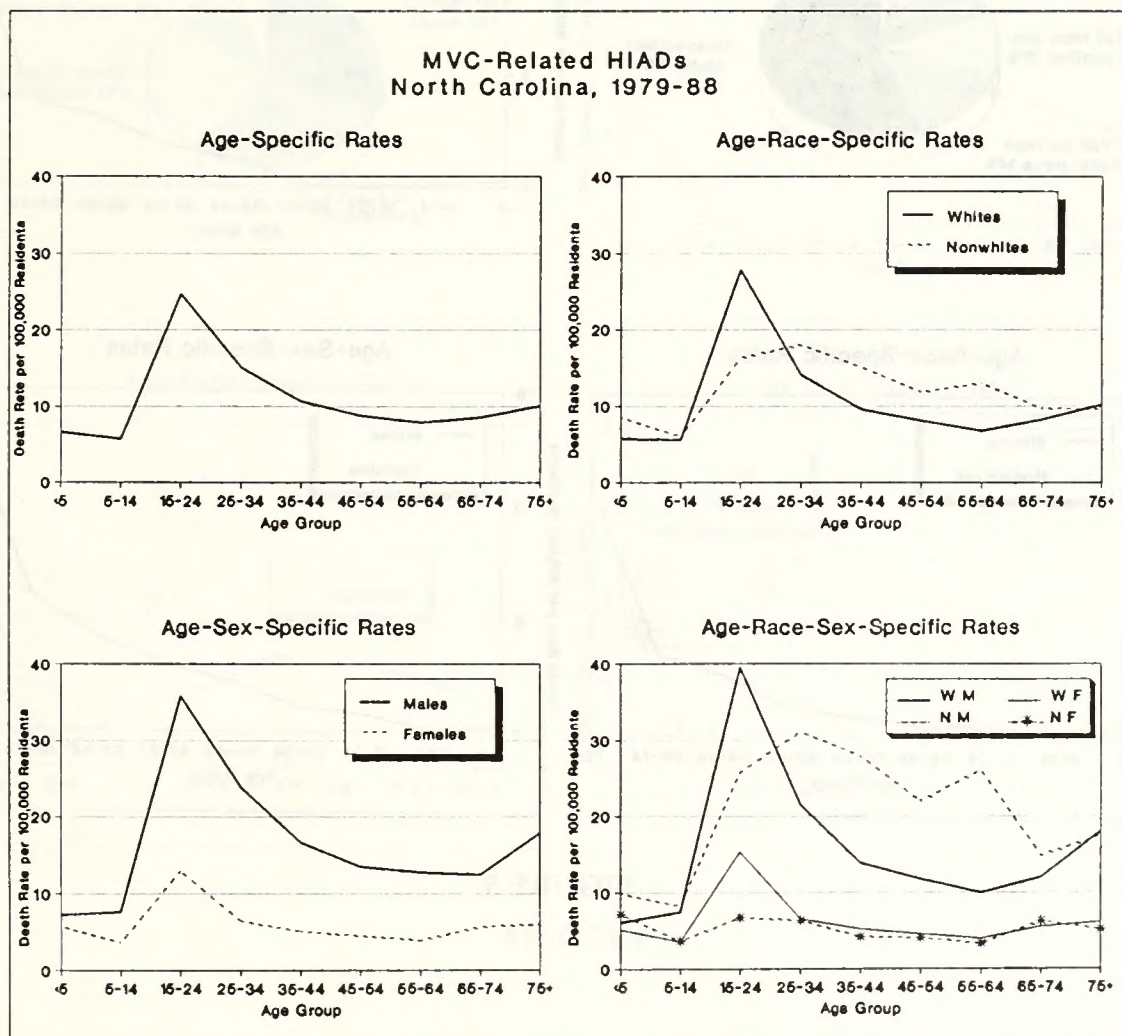


FIGURE 4

The majority of *fall-related HIADs* are of unspecified cause (see Figure 5). Falls involving stairs or steps account for the largest proportion of falls of a specified cause. The pattern of rates for falls is considerably different from that for other cause-specific HIADs. Older individuals tend to be at greater risk. Almost 75 percent of these deaths occur at ages 45 and older with the largest proportion of deaths at ages 75 and older. Age-specific rates increase steadily after ages 25-34 and rise sharply at ages 75 and older.

Age-sex-adjusted death rates for falls are similar for whites and nonwhites. The race-specific distributions of deaths and rates differ, however, across age groups. The largest proportion of deaths and the highest rates for whites occur at ages 75 and older while the highest rates for nonwhites occur after age 35 (see Tables 1 and 2).

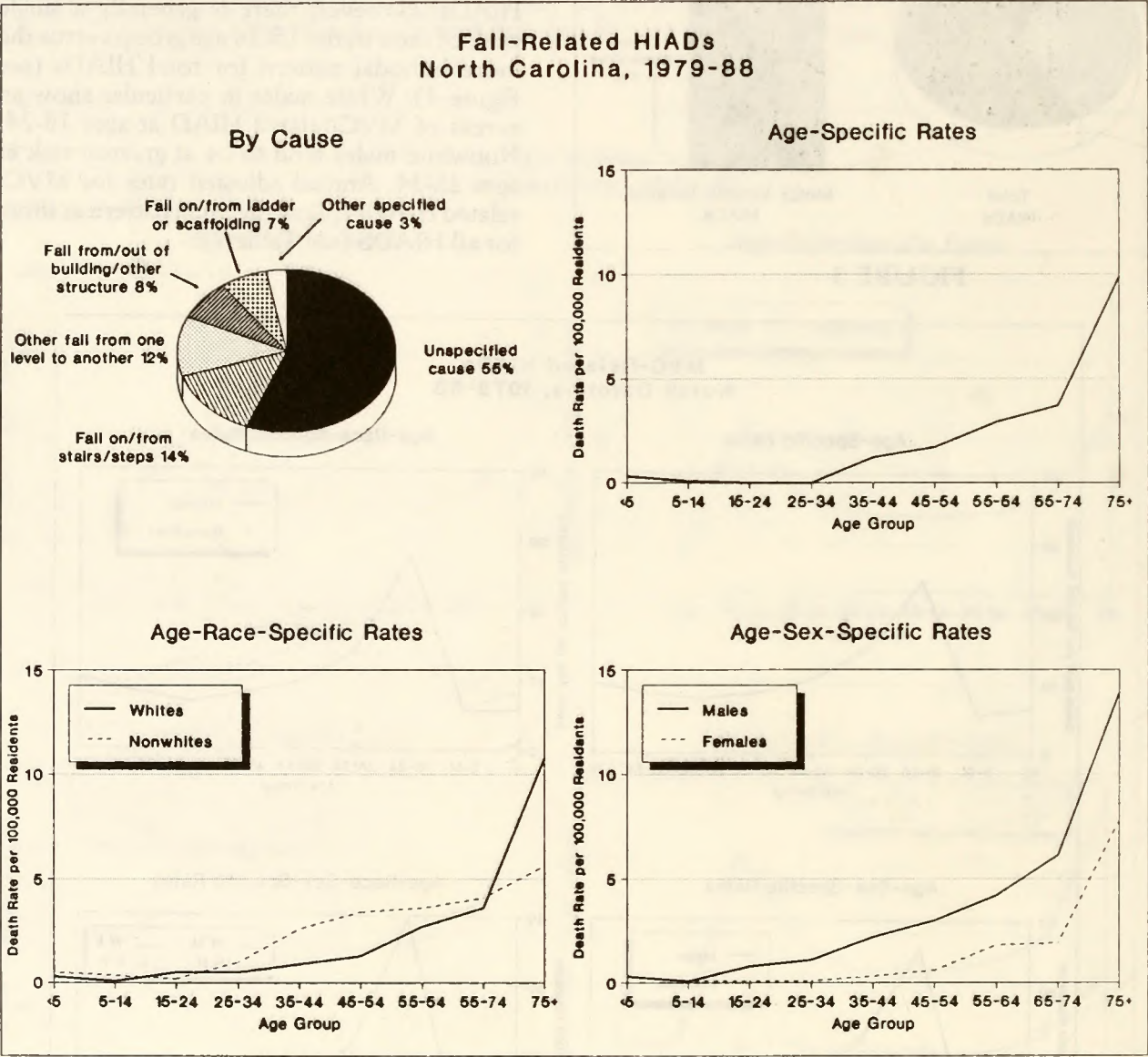


FIGURE 5



The age distribution of fall-related HIADs is similar for males and females. The largest proportion of deaths occurs at ages 75 and older. Overall, males outnumber females 2.2 to 1. Similarly, the age-race-adjusted rate for males is more than twice that for females. White males in particular show an excess of fall-related HIAD at ages 75 and older. Nonwhite males tend to be at greatest risk after age 35.

The majority of **homicide-related HIADs** involved the use of either a firearm or a blunt or thrown object. Overall, death rates are highest for ages less than five, ages 25 through 64, and those age 75 and older (see Figure 6). Rates are higher for nonwhites than for whites across all age groups with a striking racial difference at all ages except 5-14. Consequently, the age-sex-adjusted rate for nonwhites is twice that for whites. Deaths to males outnumber female deaths 2.3 to 1, with higher rates for males in all but the 5-14 age group. Similarly, the age-race-adjusted rate is higher for males than females.

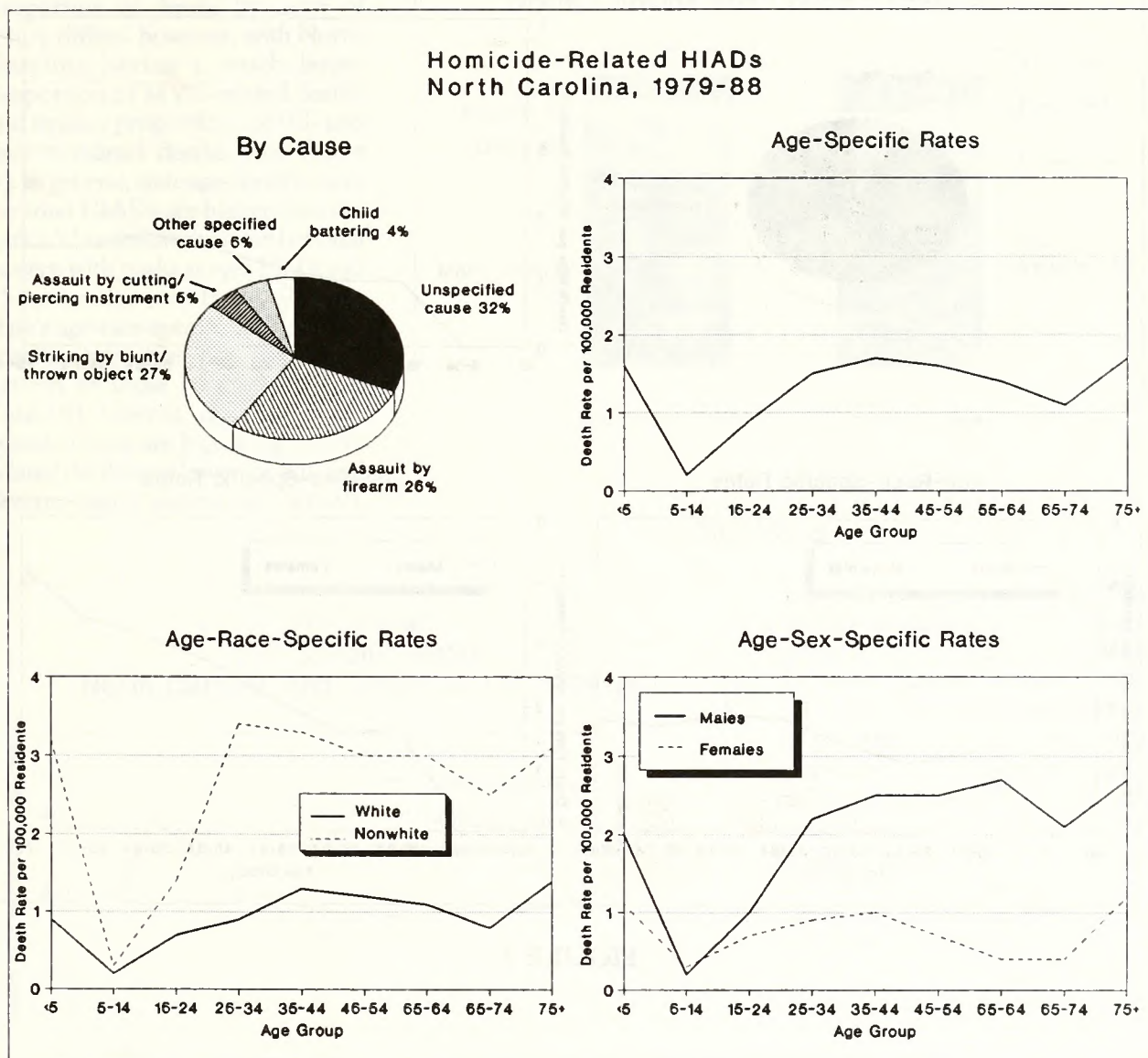


FIGURE 6

As shown in Figure 7, firearms are involved in 93 percent of **suicide-related HIADs**. Rates range between 1.0 and 1.7 across all age groups after ages 0-14. Unlike homicide-related HIAD rates, the suicide-related rates are higher for whites than nonwhites across all age groups. The age-sex-adjusted rate for whites is three times that for nonwhites. Males again outnumber females, 5.8 to 1, the highest ratio of all cause-specific HIADs. The age-race-adjusted rate for males is almost six times that for females. White males are at highest risk and account for 77 percent of the suicide-related HIADs.

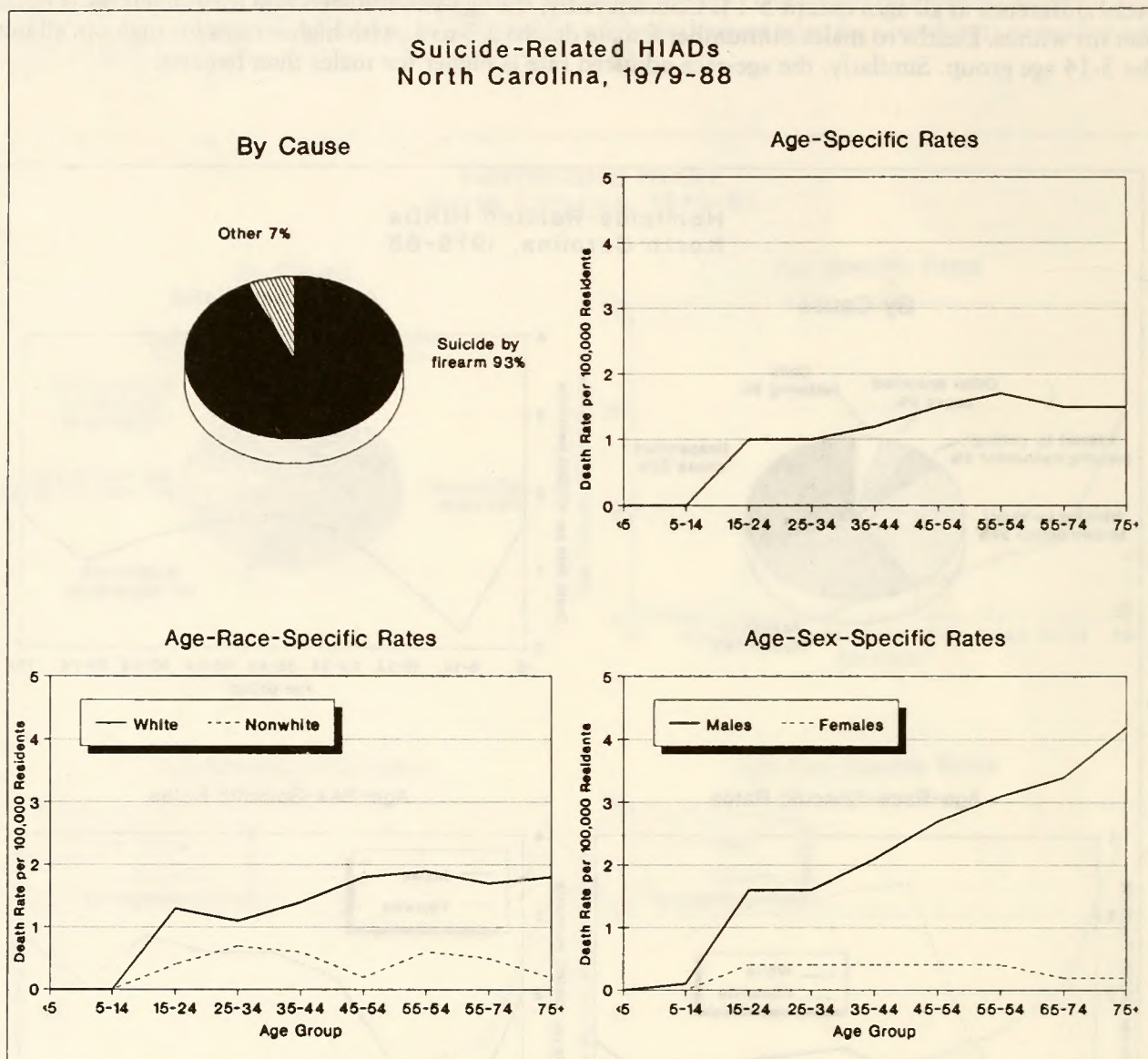


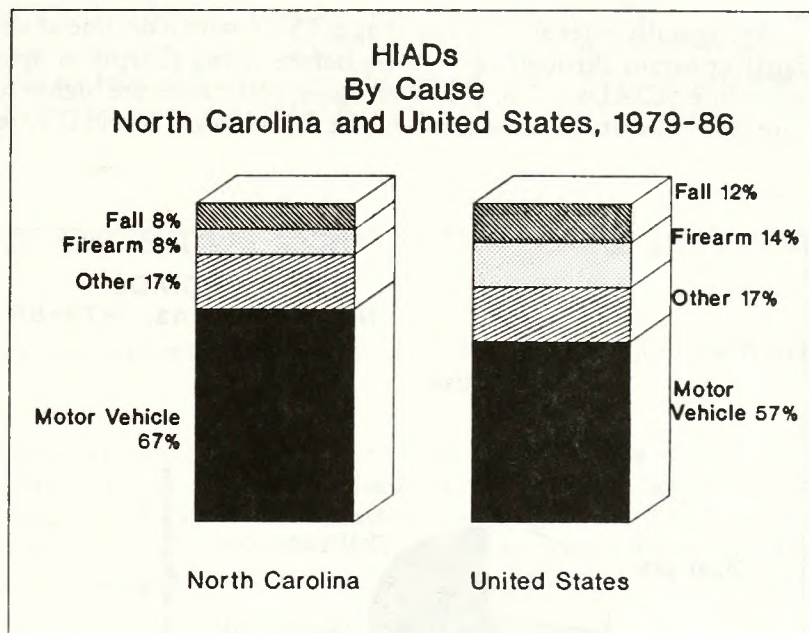
FIGURE 7



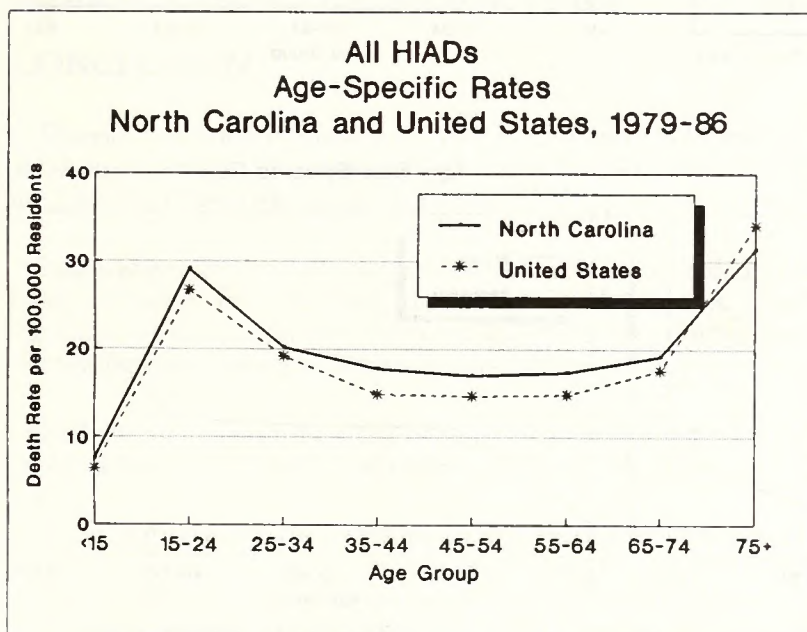
## COMPARISON OF STATE AND NATIONAL HEAD INJURY ASSOCIATED DEATH

National rates for HIADs were presented in a study by the Centers for Disease Control (8). The study covered the time period from 1979 through 1986. The present study compares those rates to corresponding rates for North Carolina. State rates for blacks are not available, however, so rates are presented for North Carolina whites and nonwhites. [Note: Blacks comprised 92.6 percent of the 1980 North Carolina nonwhite population (10).] Adjusted rates were calculated using the U.S. 1980 Census population as the standard. HIADs are categorized according to the underlying cause of death as follows: MVCs (E810-E825); falls (E880-E888); and firearms (E922, E955.0-E955.4, E965.0-E965.4, E970, and E985-E985.4).

Between 1979 and 1986, head injury was involved in approximately 26 percent of all injury deaths for both the state and the nation. The proportion of deaths by cause of injury differs, however, with North Carolina having a much larger proportion of MVC-related deaths and smaller proportions of fall- and firearm-related deaths. (see Figure 8). In general, state age-specific rates for total HIADs are higher than the nation's but follow the same bimodal pattern with peaks at ages 15-24 and 75 and older (see Figure 9). The state's age-specific and age-sex-specific rates are also similar in pattern to those of the U.S. (see Table 8). Overall, the state's age-adjusted rates are higher for MVC-related deaths and lower for fall- and firearm-related deaths (see Table 9).



**FIGURE 8**



**FIGURE 9**

Among firearm-related HIADs, the national age-sex-adjusted rate is higher for blacks than whites while the reverse is true for the state (see Table 10). The state's rate is almost 78 percent higher for whites than nonwhites. When firearm-related HIADs are examined by underlying cause, though, the state and national age-sex-adjusted rates are in the same direction: the homicide rate is higher for nonwhites than whites and the suicide rate is higher for whites than nonwhites. However, the national homicide rate for blacks is much higher than that for N.C. nonwhites. Also, U.S. males are at much greater risk of firearm-related HIAD than North Carolina males (see Table 11).



## SPINAL CORD INJURY-ASSOCIATED DEATHS

Tables 12 and 13 show the number of deaths and death rates respectively for 1979-88 SCIADs by age, race, sex and underlying cause of death. These data and other details about North Carolina spinal cord injury deaths are highlighted below.

Between 1979 and 1988, there were 493 spinal cord injury-associated deaths (SCIADs) in North Carolina. These deaths are most often related to motor vehicle collisions and falls. Most SCIADs (58%) occur to persons under age 45. The state's annual age-race-sex-adjusted rates fluctuated between 0.6 and 1.1 between 1979 and 1988. The annualized rate for the 10-year period was 0.8 (see Table 7).

Age-specific rates show a rise at ages 15-24 with a decline at ages 25-44 (see Figure 10). Rates remain fairly constant through ages 45-64 before rising sharply at ages 65 and older. The ratio of white to nonwhite SCIADs is 1.6. However, age-specific rates are higher for nonwhites, and the age-sex-adjusted rate for nonwhites is almost twice that for whites, 1.2 and 0.7, respectively.

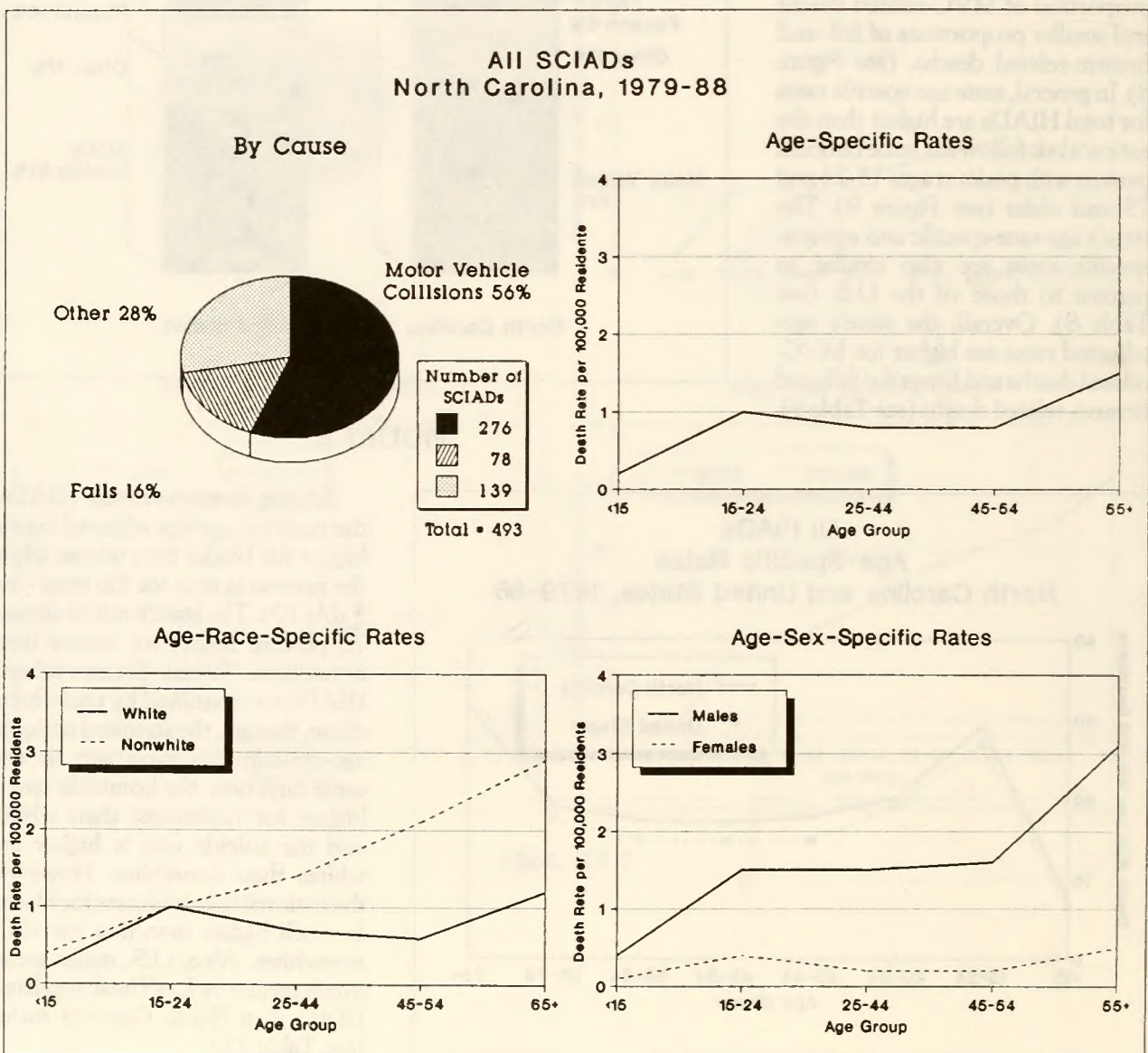


FIGURE 10



Similar to HIADs, the majority of SCIADs are males but with a higher male-to-female ratio of 5.8. Rates are higher for males than females across all age groups. Nonwhite males in particular have high rates across all age groups (see Table 13). The age-race-adjusted rate for males (1.4) is seven times that for females (0.2).

Drivers and passengers of motor vehicles (other than a motorcycle) account for the majority of MVC-related SCIADs. More than 72 percent of these deaths involve ages 44 and younger. The highest death rate occurs at ages 15-24. The age-sex-adjusted rate is, again, considerably higher for nonwhites than whites, 0.7 and 0.4 respectively. The age-race-adjusted rate is also higher for males (0.8) than females (0.1).

Falls from one level to another and falls from a building or other structure account for the largest proportion of cause-specific fall-related SCIADs (38%). The majority of fall-related SCIADs involve males (almost 90 percent) with an almost even split between race groups. More than 47 percent of the deaths occur at ages 65 and older. All female decedents are from this age group. The age-sex-adjusted rate is again higher for nonwhites (0.3) than whites (0.1) and the age-race-adjusted rate higher for males (0.2) than females (0.0).

## **COMPARISON OF 1988 HEAD AND SPINAL CORD INJURY MORBIDITY AND MORTALITY**

As expected, hospitalized survivors far outnumber deaths. The ratios are 4.4 for head injury and 6.0 for spinal cord injury.

Head injury death rates and hospitalization rates for survivors are both highest at ages 75 and older; however, the death rate is almost as high at ages 15-24. The death rate is lowest at ages 5-14, the hospitalization rate at ages 55-64. The highest ratio of survivors to deaths occurs at ages 5-14, the lowest ratio at ages 75 and older (see Table 14). Spinal cord injury death rates and hospitalization rates for survivors are both highest at ages 15-24 and lowest at ages younger than 15 (see Table 15). The highest ratio of survivors to deaths occurs at ages 25-44.

Males have much higher death rates and hospitalization rates than females for both head and spinal cord injuries (see Tables 16 and 17). Ratios of survivors to deaths are higher for females than males for both head and spinal cord injuries, with the greatest difference between spinal cord death and hospitalization rates.

## **CONCLUSION**

Overall, males are at greatest risk of HIAD at ages 15-24 and ages 75 and older. White males in particular show an excess of MVC-related HIAD at ages 15-24 and fall-related HIAD at ages 75 and older. White males are also at greatest risk of suicide-related HIAD, most often involving the use of a firearm.

Nonwhite males tend to be at greatest risk of MVC-related HIAD at ages 25-34. Fall-related HIAD is also more prevalent for nonwhite males between the ages of 25-34 and 65-74, raising the possibility of occupation-related injuries. Place of injury is too often missing on the death record to make this determination. Nonwhite males also have an excess of homicide-related HIAD.

Males are by far at greatest risk of SCIAD. In general, rates are highest for nonwhite males. The rate for this group is highest at ages 65 and older.

Because motor vehicle collisions are involved in the majority of HIADs and SCIADs, injury prevention strategies which reduce the incidence and severity of MVC-related injuries should be continued and expanded. Prevention programs involving seat belt and air bag use, reduction of drinking and driving, and the use of bicycle and motorcycle helmets could help lower the incidence of these injuries.



Prevention of falls is difficult due to the variety of circumstances involved in falls and the lack of detailed information concerning types of falls. Although falls are the second leading cause of HIAD and SCIAD in North Carolina, the possibility exists that HIADs and SCIADs from falls are considerably underreported, particularly among the elderly. Older people tend to die later after injury than younger people do (13). An injury that begins a chain of events leading to death may not be recognized as the cause of death after a period of time. Fall prevention needs to be focused on both the environment and the activities of those at highest risk. Investigation into involvement of occupation-related head and spinal cord injury resulting from falls is warranted, particularly among the nonwhite population.

Both suicide and homicide prevention involve complicated issues for which there are no easy answers. The use of alcohol has been suggested as a possible risk factor. Firearms are often involved in suicide and homicide deaths and the effects of gun control may hold promise. The effectiveness of programs to refocus and redirect hostile feelings in reducing assault have not been fully evaluated, nor have intervention programs for those identified at risk of suicide. (14)

Detailed cause of injury information is necessary for the development of effective injury prevention programs. Many fatal injuries are not specific as to cause. Better documentation of cause of injury is needed on the death certificate. The existing hospital discharge data system in North Carolina lacks cause of injury reporting as well as information concerning race. Relationships may exist between the cause of injury, the type of injury that results, and survival after injury; but this cannot be determined by comparing existing morbidity and mortality data.

Because cause of injury data were included in the collection of North Carolina Trauma Registry data (data from the eight Trauma Centers in North Carolina), a comparison of data among hospitals with and without a trauma registry was made (15). The Trauma Registry data were not representative of all North Carolina head and spinal cord injury hospitalizations. Incidence of injury differed in several respects. Patients under age 55 and males are overrepresented while those 75 and older are considerably underrepresented in the Trauma Registry. The Center for Health and Environmental Statistics is participating in a study to adjust Trauma Registry data to better reflect the injury experience in North Carolina. Until E-codes can be added to hospital discharge data, this adjusted database will serve as the source of information on cause of injury for hospitalizations.



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Table 1

NUMBER OF HEAD INJURY-ASSOCIATED DEATHS  
BY AGE, RACE, SEX, AND CAUSE  
NORTH CAROLINA, 1979-88

			Race and Sex							
Cause	Age Group	Total Deaths	Total Whites	White Males	White Females	Total Nonwhites	Nonwhite Males	Nonwhite Females	Total Males	Total Females
All	<5	410	235	136	99	175	104	71	240	170
	5-14	593	405	277	128	188	129	59	406	187
	15-24	3235	2636	1980	656	599	469	130	2449	786
	25-34	2064	1417	1103	314	647	525	122	1628	436
	35-44	1370	949	716	233	421	340	81	1056	314
	45-54	1016	743	561	182	273	222	51	783	233
	55-64	950	707	524	183	243	203	40	727	223
	65-74	808	619	419	200	189	130	59	549	259
	75+	871	731	408	323	140	85	55	493	378
	Total	11317	8442	6124	2318	2875	2207	668	8331	2986
MVC	<5	272	165	92	73	107	62	45	154	118
	5-14	517	351	241	110	166	115	51	356	161
	15-24	2775	2266	1669	597	509	404	105	2073	702
	25-34	1550	1093	840	253	457	371	86	1211	339
	35-44	853	604	434	170	249	212	37	646	207
	45-54	547	407	287	120	140	113	27	400	147
	55-64	454	315	215	100	139	119	20	334	120
	65-74	360	281	171	110	79	49	30	220	140
	75+	262	216	129	87	46	30	16	159	103
	Total	7590	5698	4078	1620	1892	1475	417	5553	2037
Fall	<5	14	8	3	5	6	4	2	7	7
	5-14	8	7	5	2	1	0	1	5	3
	15-24	51	44	40	4	7	7	0	47	4
	25-34	62	37	33	4	25	23	2	56	6
	35-44	98	56	49	7	42	35	7	84	14
	45-54	108	68	55	13	40	34	6	89	19
	55-64	165	126	80	46	39	29	10	109	56
	65-74	154	121	82	39	33	25	8	107	47
	75+	256	229	107	122	27	16	11	123	133
	Total	916	696	454	242	220	173	47	627	289
Homicide	<5	65	25	18	7	40	25	15	43	22
	5-14	19	10	4	6	9	3	6	7	12
	15-24	98	54	35	19	44	24	20	59	39
	25-34	158	71	51	20	87	61	26	112	46
	35-44	136	82	59	23	54	36	18	95	41
	45-54	97	62	43	19	35	31	4	74	23
	55-64	83	51	45	6	32	25	7	70	13
	65-74	46	26	19	7	20	17	3	36	10
	75+	45	30	12	18	15	12	3	24	21
	Total	747	411	286	125	336	234	102	520	227
Suicide	<5	0	0	0	0	0	0	0	0	0
	5-14	4	3	3	0	1	1	0	4	0
	15-24	117	104	83	21	13	12	1	95	22
	25-34	100	82	64	18	18	17	1	81	19
	35-44	99	89	74	15	10	9	1	83	16
	45-54	94	92	80	12	2	1	1	81	13
	55-64	95	89	76	13	6	6	0	82	13
	65-74	63	59	55	4	4	4	0	59	4
	75+	40	39	36	3	1	1	0	37	3
	Total	612	557	471	86	55	51	4	522	90



Table 2

HEAD INJURY-ASSOCIATED DEATH RATES  
BY AGE, RACE, SEX, AND CAUSE  
NORTH CAROLINA, 1979-88

			Race and Sex							
Cause	Age Group	Total Deaths	Total Whites	White Males	White Females	Total Nonwhites	Nonwhite Males	Nonwhite Females	Total Males	Total Females
All	<5	9.9	8.1	9.2	7.0	13.9	16.5	11.3	11.4	8.4
	5-14	6.6	6.4	8.6	4.2	6.8	9.4	4.3	8.8	4.2
	15-24	28.8	32.5	47.0	16.8	19.2	29.8	8.4	42.3	14.4
	25-34	20.1	18.3	28.3	8.2	25.5	44.1	9.1	32.0	8.4
	35-44	17.2	15.1	23.0	7.3	25.6	44.8	9.2	27.3	7.7
	45-54	16.3	14.7	23.0	7.0	23.3	43.0	7.8	26.5	7.1
	55-64	16.6	15.2	24.3	7.3	22.7	44.3	6.5	27.8	7.2
	65-74	19.3	18.3	29.5	10.2	23.3	39.2	12.3	31.3	10.6
	75+	33.6	34.6	57.0	23.1	29.2	49.6	17.9	55.5	22.2
	All Ages	18.4	18.1	27.0	9.7	19.4	31.5	8.5	28.1	9.4
MVC	<5	6.6	5.7	6.2	5.2	8.5	9.9	7.2	7.3	5.8
	5-14	5.7	5.6	7.5	3.6	6.0	8.3	3.7	7.7	3.6
	15-24	24.7	27.9	39.6	15.3	16.3	25.7	6.8	35.8	12.9
	25-34	15.1	14.1	21.5	6.6	18.0	31.1	6.4	23.8	6.5
	35-44	10.7	9.6	13.9	5.3	15.1	27.9	4.2	16.7	5.1
	45-54	8.8	8.1	11.8	4.6	11.9	21.9	4.1	13.5	4.5
	55-64	7.9	6.8	10.0	4.0	13.0	26.0	3.3	12.8	3.9
	65-74	8.6	8.3	12.0	5.6	9.7	14.8	6.3	12.5	5.7
	75+	10.1	10.2	18.0	6.2	9.6	17.5	5.2	17.9	6.0
	All Ages	12.4	12.2	18.0	6.8	12.7	21.0	5.3	18.7	6.4
Fall	<5	0.3	0.3	0.2	0.4	0.5	0.6	0.3	0.3	0.3
	5-14	0.1	0.1	0.2	0.1	0.0	0.0	0.1	0.1	0.1
	15-24	0.0	0.5	0.9	0.1	0.2	0.4	0.0	0.8	0.1
	25-34	0.0	0.5	0.8	0.1	1.0	1.9	0.1	1.1	0.1
	35-44	1.2	0.9	1.6	0.2	2.6	4.6	0.8	2.2	0.3
	45-54	1.7	1.3	2.3	0.5	3.4	6.6	0.9	3.0	0.6
	55-64	2.9	2.7	3.7	1.8	3.6	6.3	1.6	4.2	1.8
	65-74	3.7	3.6	5.8	2.0	4.1	7.5	1.7	6.1	1.9
	75+	9.9	10.8	14.9	8.7	5.6	9.3	3.6	13.9	7.8
	All Ages	1.5	1.5	2.0	1.0	1.5	2.5	0.6	2.1	0.9
Homicide	<5	1.6	0.9	1.2	0.5	3.2	4.0	2.4	2.0	1.1
	5-14	0.2	0.2	0.1	0.2	0.3	0.2	0.4	0.2	0.3
	15-24	0.9	0.7	0.8	0.5	1.4	1.5	1.3	1.0	0.7
	25-34	1.5	0.9	1.3	0.5	3.4	5.1	1.9	2.2	0.9
	35-44	1.7	1.3	1.9	0.7	3.3	4.7	2.0	2.5	1.0
	45-54	1.6	1.2	1.8	0.7	3.0	6.0	0.6	2.5	0.7
	55-64	1.4	1.1	2.1	0.2	3.0	5.5	1.1	2.7	0.4
	65-74	1.1	0.8	1.3	0.4	2.5	5.1	0.6	2.1	0.4
	75+	1.7	1.4	1.7	1.3	3.1	7.0	1.0	2.7	1.2
	All Ages	1.2	0.9	1.3	0.5	2.3	3.3	1.3	1.8	0.7
Suicide	<5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5-14	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0
	15-24	1.0	1.3	2.0	0.5	0.4	0.8	0.1	1.6	0.4
	25-34	1.0	1.1	1.6	0.5	0.7	1.4	0.1	1.6	0.4
	35-44	1.2	1.4	2.4	0.5	0.6	1.2	0.1	2.1	0.4
	45-54	1.5	1.8	3.3	0.5	0.2	0.2	0.2	2.7	0.4
	55-64	1.7	1.9	3.5	0.5	0.6	1.3	0.0	3.1	0.4
	65-74	1.5	1.7	3.9	0.2	0.5	1.2	0.0	3.4	0.2
	75+	1.5	1.8	5.0	0.2	0.2	0.6	0.0	4.2	0.2
	All Ages	1.0	1.2	2.1	0.4	0.4	0.7	0.1	1.8	0.3



Table 3

**AVERAGE YEARS OF LIFE LOST \*  
NORTH CAROLINA, 1988**

Cause of Death	Average Years of Life Lost
Head Injury	35
Spinal Cord Injury	33
ALL INJURY	31
Chronic Liver Disease	16
ALL DEATHS	10
Cancer	9
Diabetes	8
Septicemia	8
Kidney Disease	7
Pulmonary Disease	6
Heart Disease	5
Pneumonia & Influenza	5
Stroke	4
Atherosclerosis	2

\* Average years of life lost by all decedents. The following projected 1990 life expectancies for North Carolina were used to calculate average years of life lost: 72 for white males, 80 for white females, 67 for nonwhite males, and 76 for nonwhite females. (Source: N.C. Office of State Budget and Management.)

Table 4

**AGE-SEX-ADJUSTED HIAD RATES  
BY RACE AND CAUSE  
NORTH CAROLINA, 1979-88**

Cause	White	Nonwhite
All	18.1	19.1
Motor Vehicle	12.4	12.7
Fall	1.4	1.4
Homicide	0.9	2.2
Suicide	1.2	0.4

Note: 1980 North Carolina population used as standard.

Table 5

**AGE-RACE-ADJUSTED HIAD RATES  
BY SEX AND CAUSE  
NORTH CAROLINA, 1979-88**

Cause	Male	Female
All	27.9	9.3
Motor Vehicle	18.8	6.5
Fall	2.0	0.8
Homicide	1.7	0.7
Suicide	1.7	0.3

Note: 1980 North Carolina population used as standard.



Table 6

**AGE-ADJUSTED HIAD RATES  
BY RACE-SEX AND CAUSE  
NORTH CAROLINA, 1979-88**

Cause	White Male	Nonwhite Male	White Female	Nonwhite Female
All	26.9	30.8	9.6	8.4
Motor Vehicle	18.1	20.7	6.9	5.4
Fall	1.9	2.3	0.9	0.6
Homicide	1.2	3.2	0.5	1.3
Suicide	2.0	0.7	0.4	0.1

Note: 1980 North Carolina population used as standard.

Table 7

**ANNUAL HIAD AND SCIAD RATES  
AGE-RACE-SEX-ADJUSTED BY CAUSE  
NORTH CAROLINA, 1979-1988**

Year	HIADS					SCIADS
	All	Motor Vehicle	Fall	Homicide	Suicide	All
1979	20.2	13.9	1.4	1.2	1.3	1.1
1980	20.3	13.6	1.8	1.5	1.0	0.8
1981	19.8	13.7	1.4	1.2	1.0	0.8
1982	17.4	11.5	1.2	1.4	1.2	0.9
1983	16.4	10.5	1.5	1.3	1.0	0.8
1984	18.4	12.2	1.4	1.1	1.2	0.8
1985	17.7	12.1	1.4	1.1	0.9	0.7
1986	18.1	12.8	1.3	1.0	0.9	0.8
1987	17.2	11.8	1.3	1.2	0.6	0.6
1988	18.0	12.5	1.5	1.0	0.8	1.1
All Years	18.3	12.4	1.4	1.2	1.0	0.8

Note: 1980 North Carolina population used as standard.



Table 8

**HEAD INJURY-ASSOCIATED DEATH RATES  
BY AGE, RACE, SEX, AND CAUSE  
NORTH CAROLINA AND UNITED STATES, 1979-86**

		Race and Sex							
Cause	Age Group	North Carolina				United States			
		Total Whites	Total Nonwhites	Total Males	Total Females	Total Whites	Total Blacks	Total Males	Total Females
All	<15	6.9	8.8	9.5	5.4	6.2	7.7	7.8	5.0
	15-24	33.2	18.6	43.0	14.4	28.6	17.1	41.1	12.1
	25-34	18.6	25.2	32.4	8.3	18.9	22.8	31.2	7.4
	35-44	15.4	27.4	28.1	8.1	14.2	21.5	23.8	6.4
	45-54	15.4	23.6	27.5	7.4	14.1	21.1	23.4	6.6
	55-64	16.2	22.5	29.5	7.3	14.3	20.2	23.4	7.2
	65-74	18.1	23.9	31.5	10.4	17.4	19.4	27.5	10.0
	75+	32.2	28.0	52.2	20.6	34.3	30.4	55.5	22.4
MVC	<15	5.6	6.7	7.4	4.4	4.5	4.6	5.5	3.5
	15-24	28.5	15.9	36.5	12.8	22.7	9.2	31.1	9.9
	25-34	14.2	18.0	23.9	6.5	12.5	9.7	19.2	4.9
	35-44	9.7	15.3	16.8	5.1	7.8	7.6	11.9	3.9
	45-54	8.0	12.7	13.8	4.4	6.3	6.7	9.6	3.3
	55-64	7.0	12.9	13.4	3.7	5.6	6.5	8.2	3.5
	65-74	8.3	9.9	13.1	5.4	6.2	6.0	8.4	4.5
	75+	9.7	9.8	17.4	5.6	8.8	7.1	14.7	5.5
Fall	<15	0.2	0.2	0.2	0.2	0.3	0.5	0.4	0.2
	15-24	0.6	0.2	0.9	0.1	0.7	0.3	1.1	0.2
	25-34	0.5	1.0	1.0	0.1	0.8	1.3	1.4	0.2
	35-44	0.9	2.7	2.2	0.4	1.0	2.7	1.9	0.4
	45-54	1.4	3.3	3.0	0.6	1.9	4.2	3.4	0.9
	55-64	2.9	3.6	4.3	2.0	3.0	4.8	4.9	1.5
	65-74	3.7	3.8	6.3	1.8	4.8	5.1	7.3	2.9
	75+	9.9	4.9	12.2	7.2	15.1	8.8	20.6	11.3
Firearm	<15	0.1	0.1	0.2	0.0	0.2	0.3	0.3	0.1
	15-24	1.8	0.9	2.3	0.7	2.9	5.0	5.3	1.0
	25-34	1.4	2.3	2.7	0.6	3.0	6.3	5.7	1.1
	35-44	2.1	1.6	3.3	0.8	2.7	4.3	4.7	1.0
	45-54	2.5	0.4	3.7	0.7	2.8	2.9	4.6	1.0
	55-64	2.4	1.1	4.0	0.5	2.6	2.3	4.6	0.8
	65-74	2.0	0.8	3.9	0.2	2.9	1.5	5.5	0.6
	75+	2.0	0.3	4.4	0.2	3.0	1.3	7.6	0.3



Table 9

**AGE-ADJUSTED HIAD RATES BY CAUSE  
NORTH CAROLINA AND UNITED STATES, 1979-86**

Cause	N.C. Rate	U.S. Rate
All	18.6	16.9
Motor Vehicle	12.4	9.7
Fall	1.5	1.9
Firearm	1.4	2.3

Note: 1980 United States population used as standard.

Table 10

**AGE-SEX-ADJUSTED HIAD RATES  
BY RACE AND CAUSE  
NORTH CAROLINA AND UNITED STATES, 1979-86**

Cause	White		Nonwhite	Black
	N.C.	U.S.	N.C.	U.S.
All	18.4	17.0	19.0	16.8
Motor Vehicle	12.5	10.1	12.6	7.2
Fall	1.5	2.0	1.4	1.9
Firearm	1.6	2.3	0.9	3.1
Firearm-Homicide	0.28	0.47	0.55	2.25
Firearm-Suicide	1.19	1.63	0.31	0.64

Note: 1980 United States population used as standard.

Table 11

**AGE-RACE-ADJUSTED HIAD RATES  
BY SEX AND CAUSE  
NORTH CAROLINA AND UNITED STATES, 1979-86**

Cause	Male		Female	
	N.C.	U.S.	N.C.	U.S.
All	28.3	25.8	9.4	8.5
Motor Vehicle	18.8	14.6	6.4	5.1
Fall	2.1	2.7	0.9	1.2
Firearm	2.4	4.1	0.5	0.7

Note: 1980 United States population used as standard.



Table 12

**NUMBER OF SPINAL CORD INJURY-ASSOCIATED DEATHS  
BY AGE, RACE, SEX, AND CAUSE  
NORTH CAROLINA, 1979-88**

			Race and Sex							
Cause	Age Group	Total Deaths	Total Whites	White Males	White Females	Total Nonwhites	Nonwhite Males	Nonwhite Females	Total Males	Total Females
All	<15	29	14	12	2	15	12	3	24	5
	15-24	110	79	62	17	31	25	6	87	23
	25-44	149	92	80	12	57	53	4	133	16
	45-64	101	54	45	9	47	46	1	91	10
	65+	104	67	52	15	37	31	6	83	21
	Total	493	306	251	55	187	167	20	418	75
MVC	<15	22	10	9	1	12	10	2	19	3
	15-24	81	58	45	13	23	19	4	64	17
	25-44	96	59	48	11	37	34	3	82	14
	45-64	34	18	13	5	16	16	0	29	5
	65+	43	32	25	7	11	9	2	34	9
	Total	276	177	140	37	99	88	11	228	48
Fall	<15	1	0	0	0	1	1	0	1	0
	15-24	6	3	3	0	3	3	0	6	0
	25-44	12	9	9	0	3	3	0	12	0
	45-64	22	11	11	0	11	11	0	22	0
	65+	37	17	13	4	20	16	4	29	8
	Total	78	40	36	4	38	34	4	70	8

Table 13

**SPINAL CORD INJURY-ASSOCIATED DEATH RATES  
BY AGE, RACE, SEX, AND CAUSE  
NORTH CAROLINA, 1979-88**

			Race and Sex							
Cause	Age Group	Total Deaths	Total Whites	White Males	White Females	Total Nonwhite	Nonwhite Males	Nonwhite Females	Total Males	Total Females
All	<15	0.2	0.2	0.3	0.0	0.4	0.6	0.1	0.4	0.1
	15-24	1.0	1.0	1.5	0.4	1.0	1.6	0.4	1.5	0.4
	25-44	0.8	0.7	1.1	0.2	1.4	2.7	0.2	1.5	0.2
	45-64	0.8	0.6	1.0	0.2	2.1	4.7	0.1	1.6	0.2
	65+	1.5	1.2	2.4	0.4	2.9	6.2	0.8	3.1	0.5
	All Ages	0.8	0.7	1.1	0.2	1.3	2.4	0.3	1.4	0.2
MVC	<15	0.2	0.1	0.2	0.0	0.3	0.5	0.1	0.3	0.0
	15-24	0.7	0.7	1.1	0.3	0.7	1.2	0.3	1.1	0.3
	25-44	0.5	0.4	0.7	0.2	0.9	1.7	0.1	0.9	0.2
	45-64	0.3	0.2	0.3	0.1	0.7	1.6	0.0	0.5	0.1
	65+	0.6	0.6	1.2	0.2	0.9	1.8	0.3	1.3	0.2
	All Ages	0.4	0.4	0.6	0.2	0.7	1.3	0.1	0.8	0.2
Fall	<15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15-24	0.1	0.0	0.1	0.0	0.1	0.2	0.0	0.1	0.0
	25-44	0.1	0.1	0.1	0.0	0.1	0.2	0.0	0.1	0.0
	45-64	0.2	0.1	0.2	0.0	0.5	1.1	0.0	0.4	0.0
	65+	0.5	0.3	0.6	0.1	1.6	3.2	0.5	1.1	0.2
	All Ages	0.1	0.1	0.2	0.0	0.3	0.5	0.1	0.2	0.0



Table 14

NUMBER, RATE, AND RATIO OF HIADs  
AND HOSPITALIZED SURVIVORS BY AGE  
NORTH CAROLINA, 1988

Age Group	HIADs*		Hospitalized Survivors*		Ratio**
	Number	Rate	Number	Rate	
<5	55	12.8	435	101.1	7.9
5-14	64	7.3	637	72.2	10.0
15-24	301	27.5	1385	126.5	4.6
25-34	212	19.2	841	76.2	4.0
35-44	153	16.5	521	56.1	3.4
45-54	81	12.0	355	52.8	4.4
55-64	86	14.4	286	48.1	3.3
65-74	87	18.5	259	55.1	3.0
75+	136	43.8	396	127.6	2.9
Total	1175	18.1	5115	78.8	4.4

\*Late effects are not included.

\*\*Hospitalized survivors to HIADs

Table 15

NUMBER, RATE, AND RATIO OF SCIADs  
AND HOSPITALIZED SURVIVORS BY AGE  
NORTH CAROLINA, 1988

Age Group	SCIADs*		Hospitalized Survivors*		Ratio**
	Number	Rate	Number	Rate	
<15	5	0.4	15	1.1	3.0
15-24	18	1.6	106	9.7	5.9
25-44	20	1.0	137	6.7	6.9
45-64	12	0.9	76	6.0	6.3
65+	10	1.3	57	7.3	5.7
Total	65	1.0	391	6.0	6.0

\*Late effects are not included.

\*\*Hospitalized survivors to SCIADs



Table 16

**NUMBER, RATE, AND RATIO OF HIADs  
AND HOSPITALIZED SURVIVORS BY SEX  
NORTH CAROLINA, 1988**

Sex Group	HIADs*		Hospitalized Survivors*		Ratio**
	Number	Rate	Number	Rate	
Male	843	27.0	3362	107.6	4.0
Female	332	9.9	1753	52.1	5.3
Total	1175	18.1	5115	78.8	4.4

\*Late effects are not included.

\*\*Hospitalized survivors to HIADs

Table 17

**NUMBER, RATE, AND RATIO OF SCIADs  
AND HOSPITALIZED SURVIVORS BY SEX  
NORTH CAROLINA, 1988**

Sex Group	SCIADs*		Hospitalized Survivors*		Ratio**
	Number	Rate	Number	Rate	
Male	56	1.8	283	9.1	5.1
Female	9	0.3	108	3.2	12.0
Total	65	1.0	391	6.0	6.0

\*Late effects are not included.

\*\*Hospitalized survivors to SCIADs



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